Unexpected Gender and Diversity Issues in Particle Physics

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What is ‘gender’?

- ‘Gender’ refers to identities/practices/beliefs concerning the characteristics of femininity and masculinity, along with the presumed relationships among them. In some contexts gender is considered inexorably binary. Most institutions collect data on only two options, called ‘female’ and ‘male’. Facebook now offers its users up to 71 gender labels.

What is ‘diversity’?

Generally this term refers to social distinctions concerning age, classes, ethnicities, nationalities, political beliefs, races, religions, sexualities, etc. In many cases these distinctions are defined by governmental laws and regulations.

In some contexts these distinctions are assumed to be based on biological differences defined by science and medicine.

Under-representation

- In the US the term “under-representation” means that members of a demographic group appear less in some sectors than their representation in the overall population.
- For example, Asian Americans are not considered under-represented in STEM fields, relative to their proportion of the US population.
- Assertion: if there are 40% women PhDs from R-1 universities in a field, then there should be 40% representation of women post docs at R-1 universities in that field; less is under-representation.

Gender and diversity policies

Governments and other institutions often have policies, regulations, and laws about the distribution of resources according to gender and diversity criteria. Civil rights/affirmative action/quota policies are examples, but often challenged. (Quotas have been illegal in the US for about 20 years.)

To monitor such policies groups collect extensive data, but data collection about some groups is itself considered discriminatory.

Limitations in STEM data about gender & diversity, 1

Data on social characteristics of STEM practitioners generally are quite limited and available only by broad disciplinary fields, such as ‘physical sciences’ etc. Current US data are collected on 5 ethnic/racial groups, citizenship, 2 gender categories, and disability status; age data are illegal. Where I live and work asking about citizenship is considered hostile, although legal.

Limitations in STEM data about gender & diversity, 2

See links to international STEM data at these EU, NSF, OECD, & AIP sites, among others:

EU She Figures https://data.europa.eu/euodp/data/dataset/she-figures-2015-gender-in-research-and-innovation

OEDC http://www.oecd.org/gender/data/whereareto morrowsfemalescientists.htm

NSF https://www.nsf.gov/statistics/2017/nsf17310/

American Institute of Physics https://www.aip.org/member-societies/diversity-initiatives/statistics

Within the limits of current data there are broad patterns about gender & diversity in STEM worldwide

- Representation of women in the biological and physical sciences worldwide were similar in 1970; by 2000 women were at near parity in the biological sciences in many countries, with far less change in the physical sciences. Why?
- Representation of PhDs based in the US with disabilities varies significantly in 2012: physics & astronomy 3.7%, social sciences 11.3%, engineering 14%, biological sciences 14.5%. Why?

Broad patterns in STEM gender & diversity Issues, 2

- There are more women in astronomy and more minority men in high energy physics. Why?
- There seems to be more gender minorities in astronomy than in high energy physics. Why?
- There are more women in inter/multi/trans disciplinary studies than men. Why?

Inadequate theoretical frameworks

Those large differences between STEM fields on gender/diversity issues are not explained by any existing theories in

- STEM disparities studies
- STS studies
- studies in history and sociology of science
- Development/imperial/colonial science studies
- Feminist science studies

Why? They only address aggregate STEM data or take one STEM field as representative of all.

Although these 4 theories of STEM participation by under-represented groups are widely used in policy formation, they do not address the large disparities among STEM fields!

- Pipeline
- Unconscious bias
- Stereotype threat
- Visual Dominance

Given the massive limitations in data and theories about gender & diversity in particle physics …

There are great opportunities for a study of gender and diversity at CERN since it founding. The data collected would not only redefine how particle physicists, diversity researchers, and policy makers understand such issues in STEM fields and their ecologies. Studying situated, embodied knowledge-making at its fault lines also would redefine fundamentally our understanding of CERN and its place in particle physics.

Based on my research I offer some specific research queries

What are the changes over time with respect to both under-represented and 'normative' researchers working in particle physics at CERN re:

- the similarities and differences among their career, collaboration, and research practices
- How does size matter in research budgets, data, and collaborations?
- How do researcher to staff ratios and space allocation affect these practices?
- What constitutes 'critical mass' in representation for each arena: research design, collaboration, leadership, subfields, etc?

Queries 2: multiple positionalities and epistemologies as resources at CERN

- Shared "subject positions" can signal shared research practices, tacit knowledge, and enabling assumptions. How do those change?
- "Strong objectivity" standards require that all "subject positions" of researchers/resources be specified and investigated for ways they shape research epistemologies, aesthetics, ethics, problem choices, etc.
- How do multiple positionalities/epistemologies work together at CERN positively/problematically?

Research queries, 3:

How have changing digital research practices at CERN correlated with changes in

- knowledge-making infrastructures, the built environment, workforces, divisions of labor, and expertise at CERN
- knowledge transfer at CERN across generations and projects
- professional subject formations, strategic career choices, career narratives at CERN
- research roles of under-represented scientists at CERN
- relationships among CERN collaborators globally

Research hypotheses from my work, 1

There are shared patterns in strategies used by those from under-represented groups among these four practices:

- participating in collaborations and building webs of relationships among colleagues
- building narratives about these activities
- circulating their strategies among colleagues
- making and exploring large databases

Hypotheses from my work, 2:

Many from under-represented groups survive successfully at the edges of particle physics by

- working adroitly at the edges of infrastructures, disciplines, hierarchies
- assembling new resources through lateral webs of colleagues, methods, theories, and interpretation,
- renegotiating the interfaces, and
- using their lifelong experience in the margins, by always moving to the newer edges of knowledge formation.

Some key concepts in my work

- Intersectionality: Crenshaw 1989; Collins 2000
- Situated knowledge & Implosion: Haraway 1988/97
- Fault Lines: Traweek 2000 et al
- Meshworks: Escobar, deLanda, Ingold
- Fictive kinship and exchange: Vertovec 2002
- Reflexivity & Strong Objectivity: Harding, Longino
- Epistemic Justice Studies: Fortun, Fricker
- Gender performance studies: Butler, Ulrike Dahl

Key Concepts: Meshworks

- Arturo Escobar developed the concept of meshworks to describe two parallel dynamics: strategies of localization and of interweaving.
- Manuel deLanda shows how lateral meshworks and vertical networks coexist.
- Tim Ingold invokes webs of lines of movement as ways of life and skills. Henri LeFebvre describes movements of people through space as archi-textual, webs of lines on the land.

Key concepts: Fault Lines in dominant strategies for making knowledge

- 1825-1975: large explanatory schemes & meta-narratives with least number of principles
- Since the 1960s: increasing focus on transformations/transitions, fluctuations/variations/spectra, instabilities/irregularities, and complexity, including problems of many variables
- Since the 1990s: research design, methods, and interpretation in many fields have been strongly affected by trans-disciplinarity …

Crucial Opportunities for the CERN History Project

- Work closely with Idea Square to radically expand documentation of the history of trans-sector cooperation in particle physics: academia, civil society, industry, and government.
- Work closely with the CERN archive to radically expand its resources for future research, as the last CERN history project did: gather extensive data on gender/diversity and collect oral histories from everyone at CERN

Some colleagues working on gender/diversity in physics

- * **Diane Yu Gu**, UCLA, USA http://www.dianeyugu.com/bio/
  does research on migrating women engineers & scientists from China
  * **Cathrine Hasse**, DPU/Aarhus University, Denmark
  http://pure.au.dk/portal/en/persons/cathrine-hasse(5ba5eb68-a94f-4626-b074-1958780ab33a).html Her team studied different cultures of physics workplaces in Europe
  http://cordis.europa.eu/result/rcn/51993_en.html http://www.upgem.dk
  * **Jarita Holbrook**, University of Western Cape, South Africa
  https://www.nsf.gov/od/oia/activities/aaasfellows/bios/Holbrook.pdf https://www.facebook.com/drjaritaholbrook/ explores the intersection of gender, ethnicity, and race among astrophysists; she also has made 2 documentary films on these topics.
  * **Maria Ong**, TERC, Cambridge, USA
  https://www.terc.edu/display/Staff/Mia+On
  studies minority women in the physical sciences
  * **Helena Pettersson**, Umea University, Sweden
  http://www.kultmed.umu.se/om-institutionen/personal/helena-pettersson
  works on gender, migration, and internationalization among scientists
  * **Knut Sorensen,** NTNU, Norway
  http://www.ntnu.edu/employees/knut.sorensen addresses gender in engineering practices and pedagogies.